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JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

RE-ORDER NO. 66-995

Report No. 20584 QR1

FIRST QUARTERLY PROGRESS REPORT
For Period 15 July 1966 to 15 October 1966

STERILIZABLE WIDE ANGLE GAS BEARING GYRO FGG334S

Jet Propulsion Laboratory
Contract No. 951529
JPL-

HONEYWELL Aeronautical Division

20584-QR1 15 October 1966

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STERILIZABLE WIDE ANGLE GAS BEARING GYRO FGG334S

This work was performed for the Jet Propulsion Laboratory, California Institute of Technology sponsored by the National Aeronautics and Space Agency under Contract NAS 7-100.

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ILLUSTRATIONS

SECTION I
GENERAL

This is the first quarterly report submitted in accordance with Contract No. 951529 and covers the period from 15 July 1966 to 15 October 1966. The scope of the work includes fabrication, test and delivery of two GG334S gyros, and the design and development activity necessary to accomplish the device requirements as specified in the contract. Accomplishments are summarized in Section II. Section III describes detailed work progress, and Section IV describes future plans.

SECTION II
SUMMARY

Figure 1 shows that all activities are on schedule as originally defined in Honeywell Proposal 6G-D-63, on which this contract is based. Significant accomplishments during this period include:

- A detailed layout was completed
- 90 percent of the print details were completed
- Design concepts were established
- Tests were initiated to establish that all major subassemblies will meet the device requirements as defined in contract No. 951529
- All long-lead time items were ordered
- The spinmotor and gimbal piece parts are being fabricated

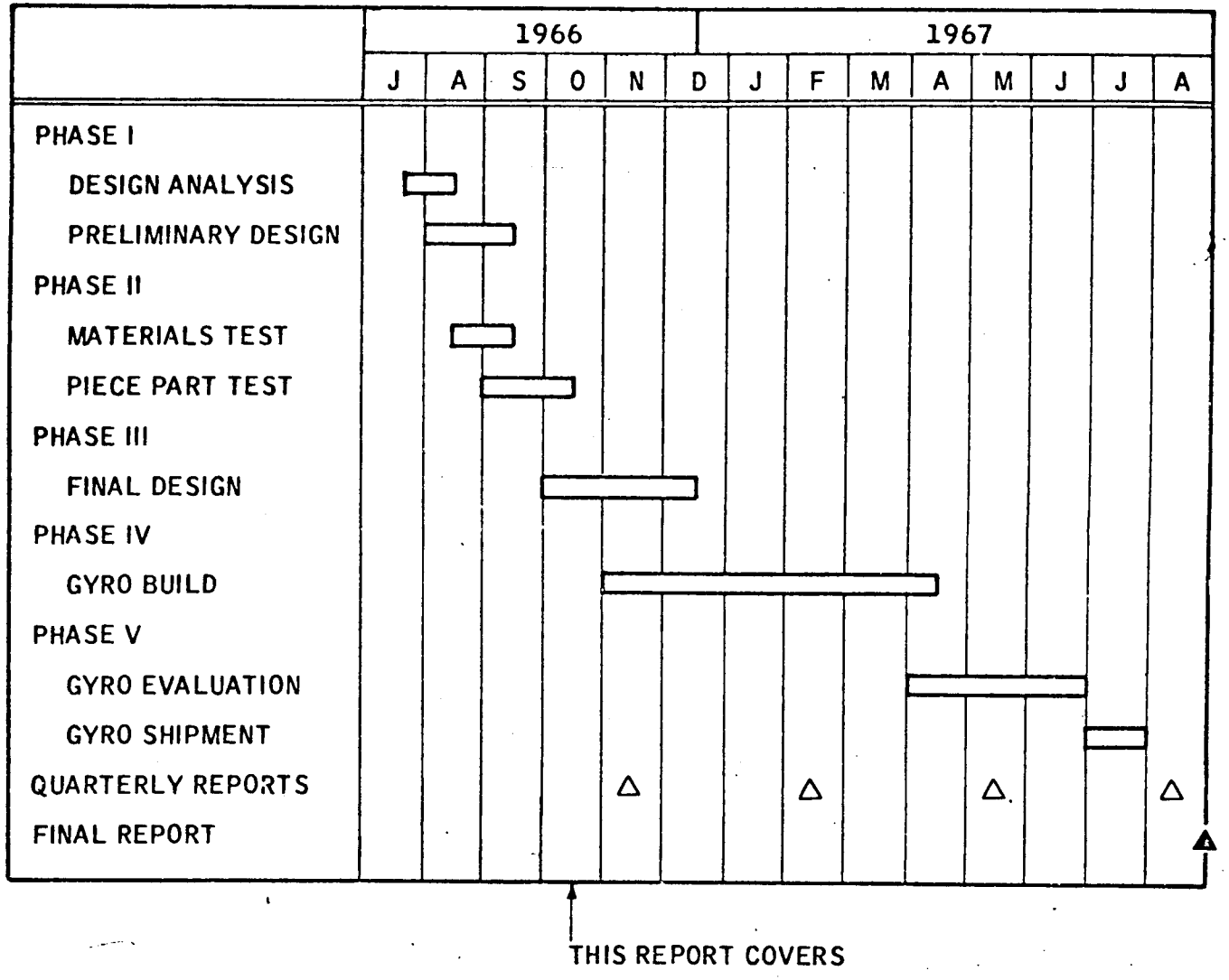


Figure 1. Proposed Program Schedule

SECTION III
WORK PROGRESS

PHASE I

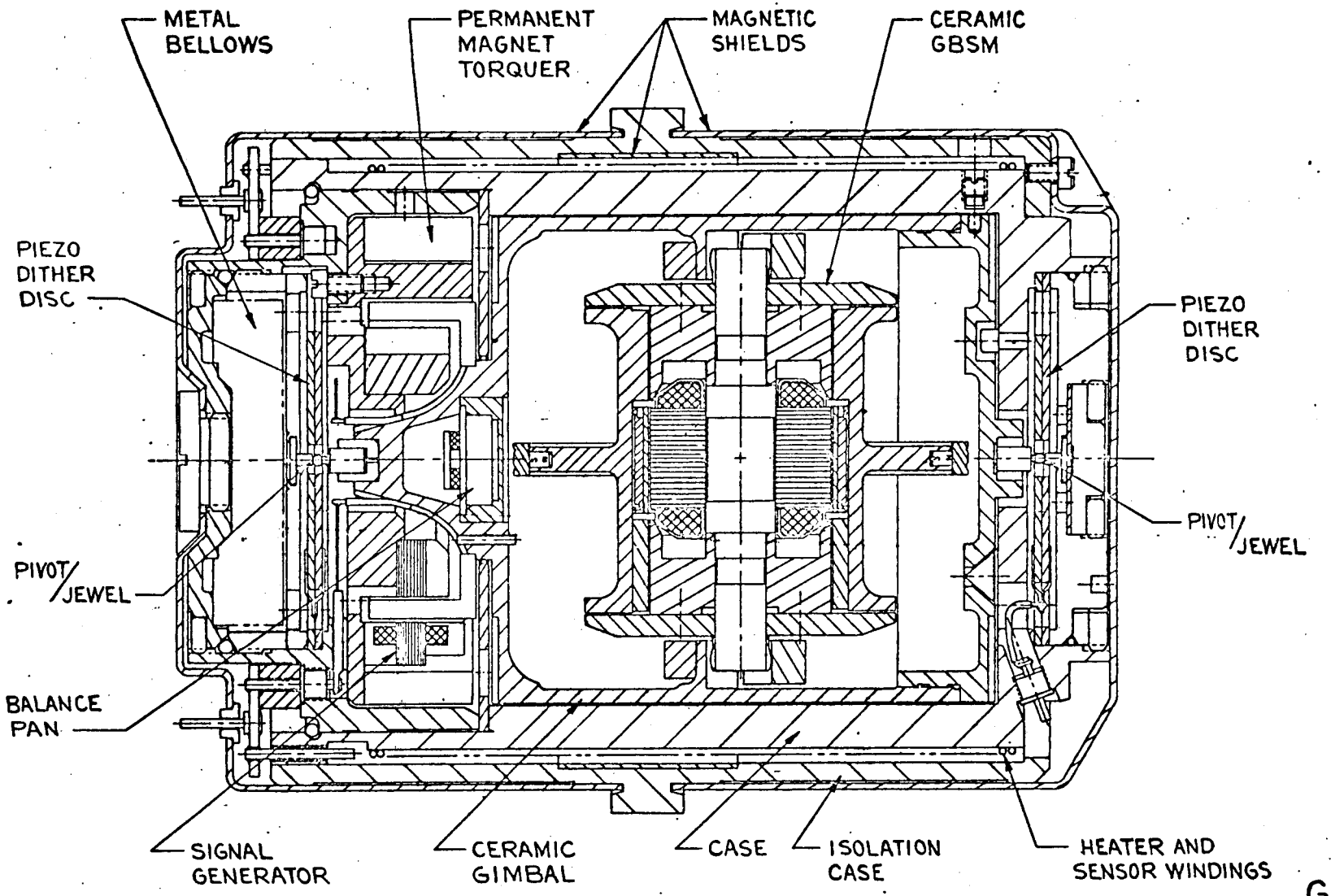
Gyro Description

A detailed layout was drawn and a complete analysis of the piece part tolerances was performed. The layout will be reviewed at the next progress meeting.

The external configuration of the FGG334S gyro is the same as the GG159D-2 fabricated under JPL Contract 951139 except that it is a cableless configuration as required by the contract. The design features of the GG159D-2 were a ceramic gas bearing spinmotor, ceramic gimbal, permanent magnet torquer and a hydrostatic pump, and has both 300°F sterilization and 200 'G' shock capability.

The subassemblies are described below.

- The GG334S gimbal, spinmotor, and case are substantially the same design as a GG159D-2.
- The torquer/signal generator is identical to the one used on the GG159 C-11 gyro except that to meet the sterilization requirement the epoxies and solder used are the same as those for the GG159D-2.
- The dither pivot/jewel scheme is the same as that for both the GG334A and GG334C and is incorporated into the GG334S gyro without change.



GG334S

Sub-Assemblies

Single Volt Start/Run Gas Bearing Spinmotor

To achieve single volt start/run operation at the required 36v 800~, it was necessary to design a "squirrel cage" type hysteresis ring with sterilization capability. Many production GG159 gyros, as well as several engineering gyros, have successfully used this "squirrel cage" type of hysteresis ring to obtain 36v start/run. The hysteresis ring consists of an inner ring with plated copper "bars" and a solid outer ring. These two rings are shrink fitted together and then ground to final dimensions as one ring.

To achieve both sterilization capability and single volt operation, the hysteresis ring complaint mount, as used on the GG159D-1 and GG159D-2 gyros, and the squirrel cage type inner ring were combined as shown in Figure 2.

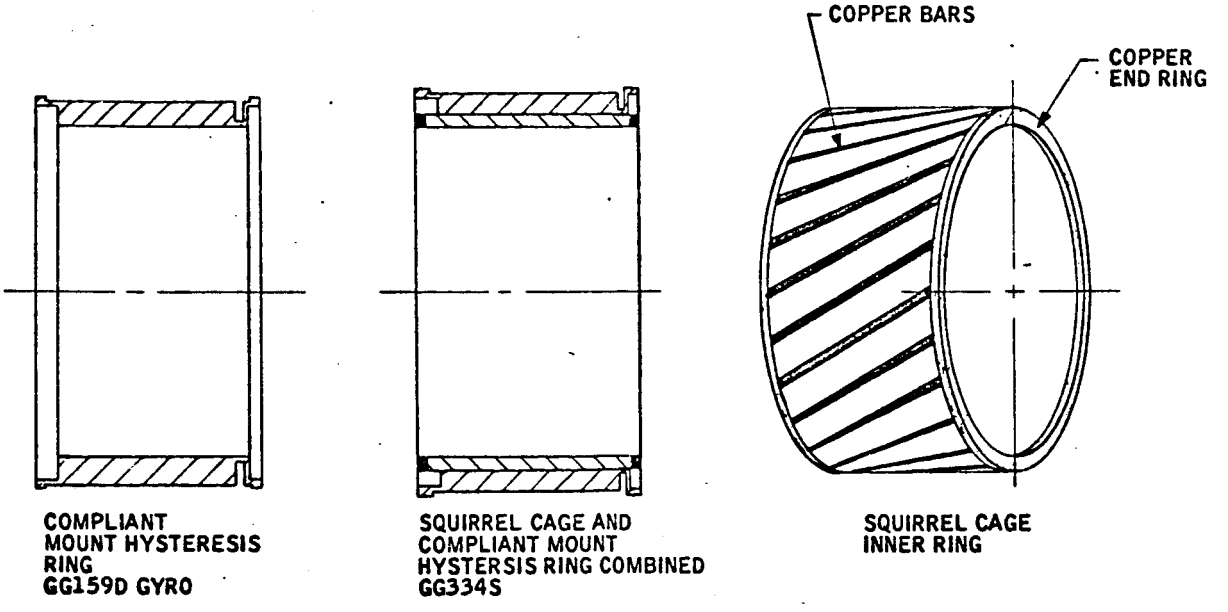


Figure 2. Hysteresis Ring Comparison

Rotor Modification for 200G Capability

Because of the geometry of the compliant mount, the outside diameter of the squirrel cage hysteresis ring, is 0.020 larger than the outside diameter of the hysteresis ring used in the GG159D gyros. This increase in the outside dimension of the hysteresis ring increases the inside dimension of the rotor. This, in turn, reduces the effective area of the thrust bearing and makes it weaker along the spin axis providing only marginal capability to meet the 200G shock requirement.

This problem was resolved by an 0.020 increase in the outside diameter of the thrust surfaces on the rotor and the outside diameter of the matching thrust plates. These details are shown in Figure 3.

The calculated stiffness of the modified configuration is 10 percent greater than that of the GG159D-2 and GG159C7 gyros with a negligible increase in power.

Gimbal Flotation

Gimbal flotation and end-to-end balance of the gimbal are more critical on a pivot/jewel gimbal suspension scheme than on the hydrostatic suspension for the GG159 gyros.

Tests on dummy parts determined the extent of the GG159 gimbal modifications, required to meet 150 milligrams, max, end-to-end and total flotation in the damping/flotation fluid with a density of 1.9 GMS/CC at 180°F.

Changes necessary to meet requirements as shown in Figure 4 are:

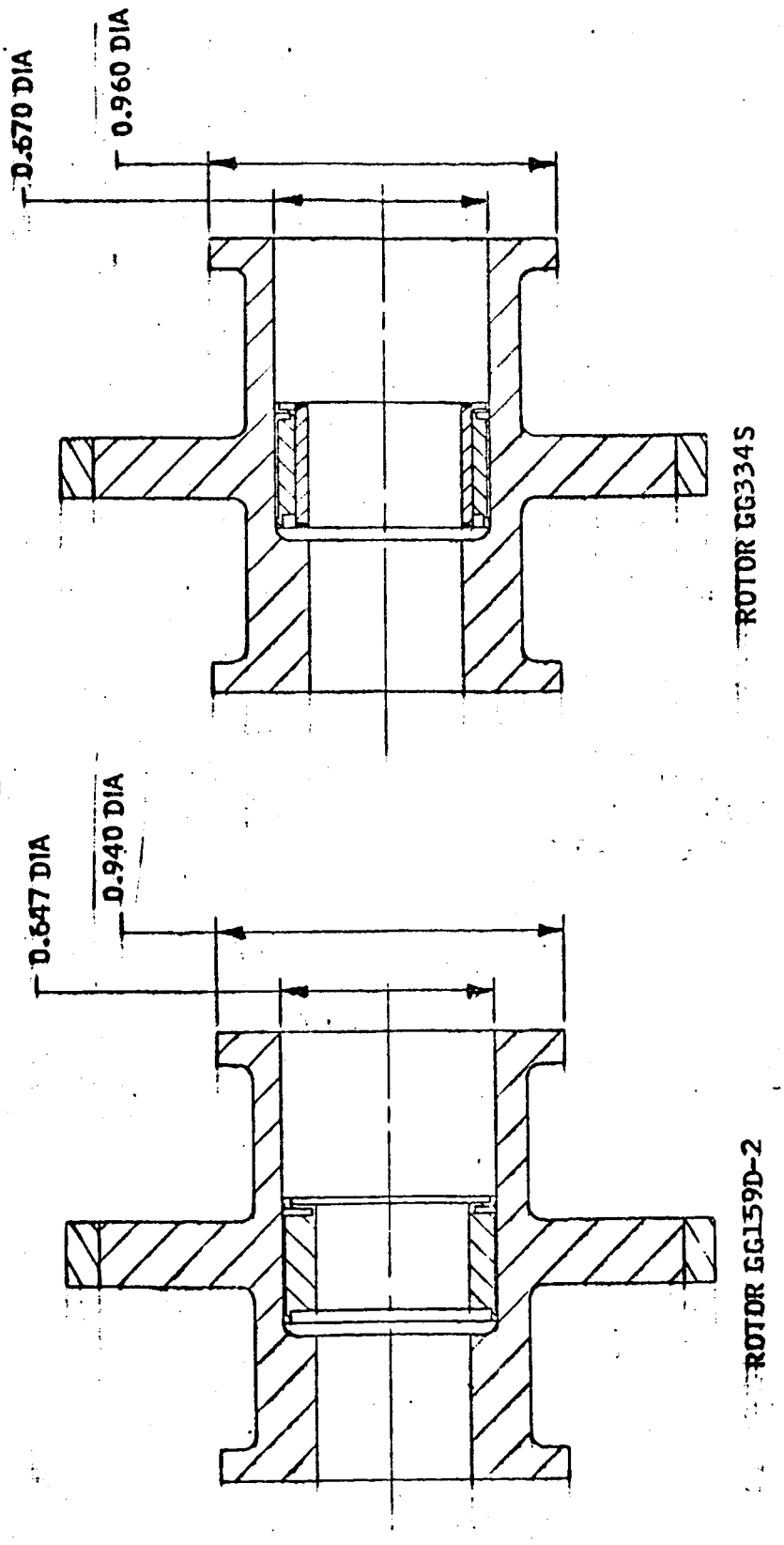


Figure 3. Rotor Dimensional Comparison

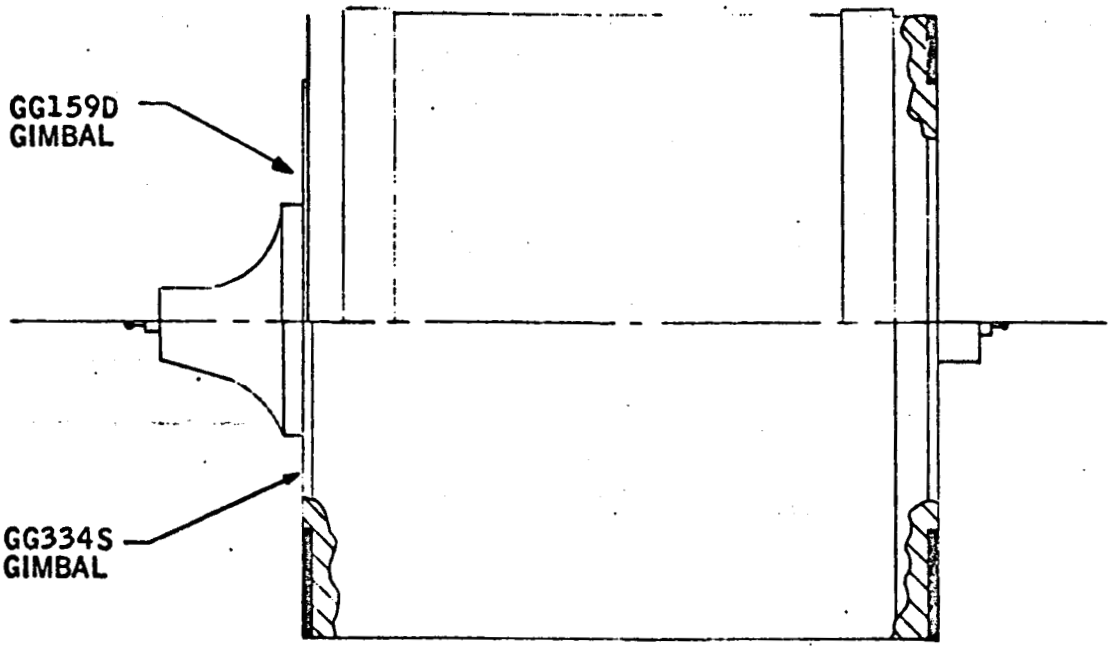


Figure 4. Gimbal Comparison

- Remove the lands on the gimbal O.D. that were required for hydrostatic suspension
- Provide a balance ring on both ends of the gimbal
- Reduce the length of the gimbal "snout".

No internal modifications to the gimbal are required to meet the GG334S requirements.

PHASE II

Sterilization Subassembly Tests

- Piezo Dither Discs -- the piezo dither discs were assembled, microscopically examined and deflection was measured with a capacitance type probe at 36v 800 cycles. The disc assembly was then

subjected to four 300°F sterilization cycles totalling 86 hours with the final cycle of 48 hours duration being the longest. Between each cycle the unit was microscopically examined and the deflection at rated voltage was measured with these results.

- No changes were observed in the surface finish.
- A slight change in deflection was noted as in Figure 5. The change following the first cycle is attributed to a minor change in the mechanical mounting. Before assembly, all the subassemblies used in this device will have a minimum of three 16 hour sterilization cycles at 300°F. Thus, the dither discs will have been thoroughly stabilized prior to final build.

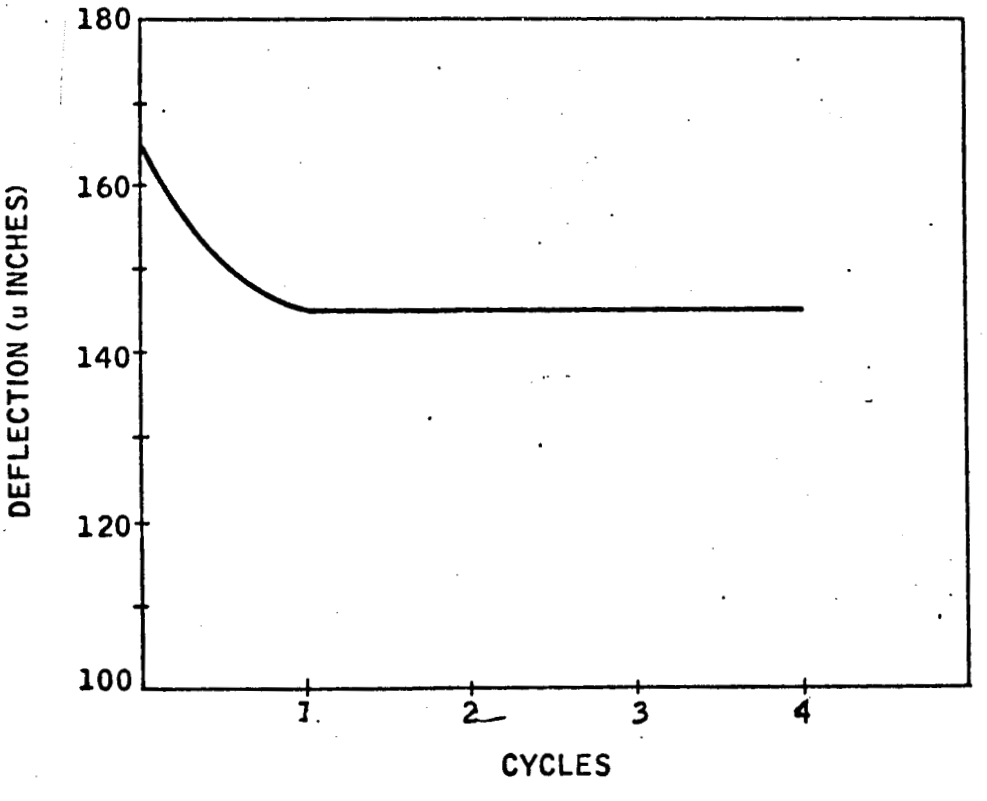


Figure 5. Dither Disc Displacement Versus Sterilization

- Torquer Generator -- The torque generator to be used in the GG334S gyro, has been successfully used on the GG159C11 Gyro It is a four pole torquer utilizing platinum/cobalt magnets as compared with a two pole torquer with alnico V magnets used in the GG159D-2 gyro.

  A torquer of this design was subjected to individual cycles of 8, 16, and 48 hours, all at 300°F. Indi-ron checks of the geometry taken before and after each cycle showed that:

- No movement of the magnets was observed after the first shift of 0.00007. See Figure 6.

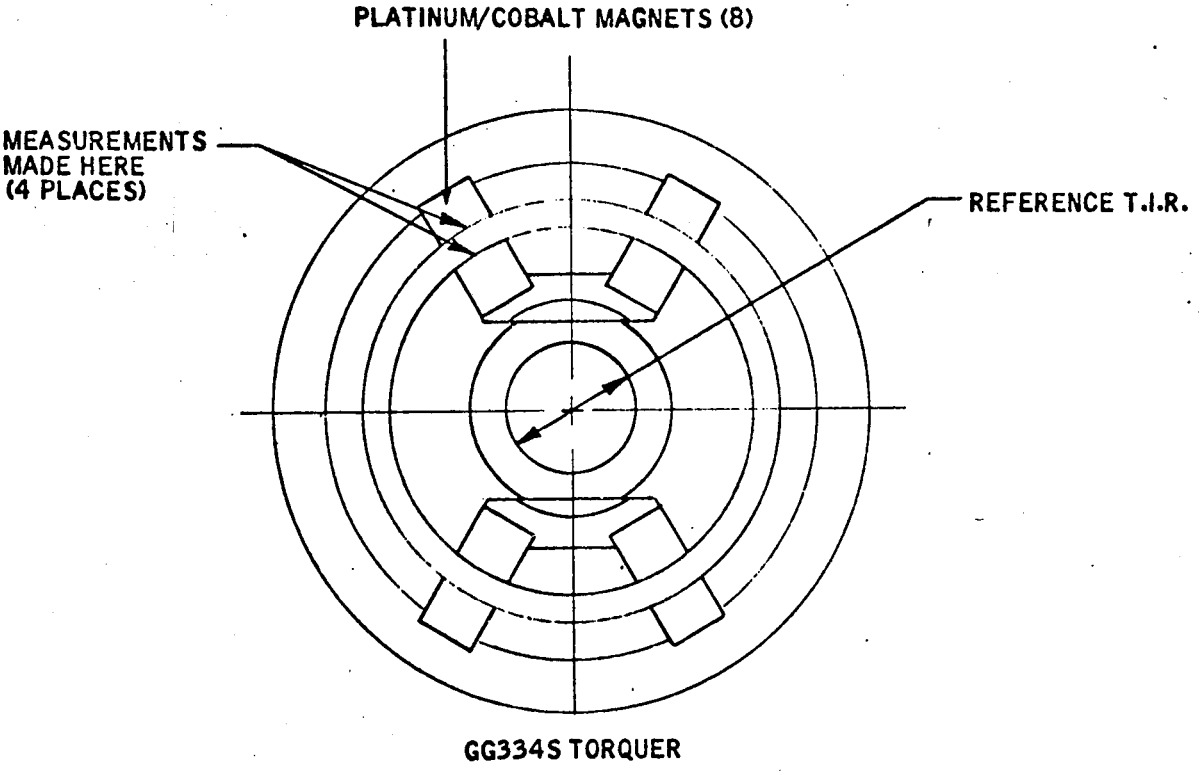


Figure 6. GG34S Torquer

As stated previously, all subassemblies will be sterilized a minimum of three cycles prior to assembly into the gyro. Because of this, no problem is foreseen in this area.

SECTION IV
FUTURE PLANS

During the next quarterly period, the following work will be accomplished:

- Dither discs will be tested for bond strength before and after sterilization.
- The hysteresis ring will be tested for changes in magnetic properties due to sterilization.
- The rotor hysteresis ring assembly will be tested for 200G shock stability after sterilization.
- Spinmotor will be shocked and vibrated to meet the contractual requirements.
- All prints will be completed.
- Fabrication will begin on all piece parts.